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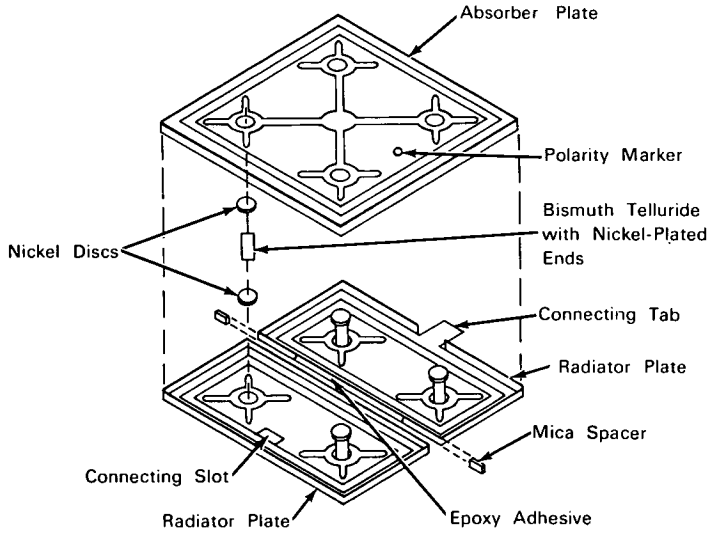
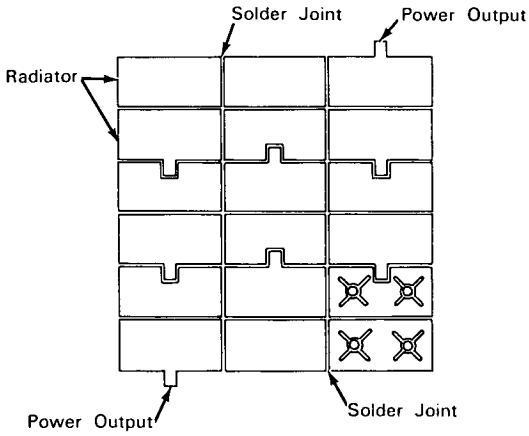
NASA TECH BRIEF

Modular Thermoelectric Cell Is Easily Packaged in Various Arrays



MODULAR CELL (Exploded View)



3X3 CELL ARRAY (Bottom View)

The problem: Designing a solar thermoelectric energy conversion device that can be easily packaged in various arrays to form power supplies having desired voltage and current output characteristics. Previous thermoelectric devices have been limited to arrays of approximately one square foot and constructed as integral strips or sheets providing undesirable low-voltage, high-current characteristics. This large thin-plate design introduces vibration and thermal stress problems in addition to fabrication and replacement difficulties.

The solution: A modular thermoelectric cell (approximately 1-inch square and 1/8-inch thick) employing two pairs of thermoelectric elements each pair of which is connected in parallel between two sets of aluminum plates. Any number of these cells can be arrayed to give the required voltage and current outputs at a relatively high efficiency and power-to-weight ratio.

How it's done: The absorber plate, made of aluminum, is coated on the top face with solar absorbing optical film. The base of the cell is made of two aluminum plates to provide a series circuit between each pair of electrically parallel thermoelectric elements. The base, which also functions as a radiator, is appropriately coated on the underside to provide for optimum dissipation of unconverted thermal energy. Mica spacers insulate the radiator plates from each other; an epoxy resin cements the plates and spacers together. The four thermoelectric elements consist of bismuth telluride with nickel plated ends which are soldered to nickel discs with a 99.5% lead–0.5% zinc solder. Each of these elements is joined to the aluminum plates with a 95% zinc–5% aluminum solder. A thin mica spacer (not illustrated) insulates the absorber plate from the radiator plates and also adds structural rigidity to the cell assembly. The radiator plates are fabricated with slots and tabs for connection

(continued overleaf)

of any number of cells in series, parallel, or series-parallel arrays.

Notes:

1. The modular cells may be easily and economically mass-produced. A variety of materials may be used, depending on the environment in which they are to function.
2. Replacement of defective cells in an array is a simple, inexpensive procedure.
3. These cells should have application as solar-energy conversion devices for terrestrial locations, space power supplies, emergency power supplies in survival kits, and as high-signal-output thermal sensing devices.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland. 20771
   Reference: B65-10199

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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(GSFC-339)